Amendments to the Claims

Please amend claims 1, 14, 15, 19, 29, 31-37, 39 and 41; cancel claim 23 without prejudice; and add claim 42.

This listing of claims will replace all prior versions, and listings, of claims in the application:

Listing of Claims:

1. (Currently amended) An annular hydrodynamic seal (103) for sealing between a first machine component (109) and a second machine component (118) having a relatively rotatable surface (115) and ~~defining a sealed partition between~~ partitioning a lubricant chamber (122) of the first machine component (109) having a first fluid (121) ~~and~~ from an environment having a second fluid (124), comprising:

A. an annular seal body (104) having a first seal end (133);

B. said annular seal body (104) defining an at least one resilient annular dynamic sealing lip (127) having an annular sloping dynamic sealing surface (140);

C. a dynamic exclusionary intersection (139) with said annular sloping dynamic sealing surface (140) for facing and preventing intrusion of the second fluid (124);

D. upon compression of said at least one resilient annular dynamic sealing lip (127) against the relatively rotatable surface (115) at least a portion of said annular sloping dynamic sealing surface (140) being deformed by and assuming the configuration of the relatively rotatable surface (115) and defining a dynamic sealing interface establishing an interfacial contact footprint having varying width (W) throughout the circumference thereof and having a

first footprint edge (157) facing the lubricant chamber (122) and the first fluid (121) and a second footprint edge (160) facing the second fluid (124);

E. an annular static sealing surface (131) defining a static sealing interface with the first machine component (109);

F. at least one energizer feature (163) loading said annular sloping dynamic sealing surface (140) into compressed sealing relation with the relatively rotatable surface (115).

2. (Original) The annular hydrodynamic seal (103) of claim 1, wherein:

said at least one resilient annular dynamic sealing lip (127) defining at least one hydrodynamic inlet curvature (142) that varies in position for providing hydrodynamic wedging action in response to relative rotation, said annular sloping dynamic sealing surface (140) being located between said hydrodynamic inlet curvature (142) and said dynamic exclusionary intersection (139) and having varying width.

3. (Original) The annular hydrodynamic seal (103) of claim 1, comprising:

said at least one energizer feature (163) being an elastomeric ring.

4. (Original) The annular hydrodynamic seal (103) of claim 1, comprising:

said at least one energizer feature (163) being at least one cantilever-type spring.

5. (Original) The annular hydrodynamic seal (103) of claim 1, comprising:

said at least one energizer feature (163) being a canted coil spring.

6. (Original) The annular hydrodynamic seal (103) of claim 1, comprising:

said at least one energizer feature (163) being a garter coil spring.

7. (Original) The annular hydrodynamic seal (103) of claim 1, comprising:

said at least one energizer feature (163) being located between said at least one resilient annular dynamic sealing lip (127) and said annular static sealing surface (131).

8. (Original) The annular hydrodynamic seal (103) of claim 1, comprising:

said at least one energizer feature (163) defining said annular static sealing surface (131).

9. (Original) The annular hydrodynamic seal (103) of claim 1, comprising:

said at least one energizer feature (163) having a modulus of elasticity less than the modulus of elasticity of said annular seal body (104).

10. (Original) The annular hydrodynamic seal (103) of claim 1, comprising:

said at least one energizer feature (163) having a modulus of elasticity greater than the modulus of elasticity of said annular seal body (104).

11. (Original) The annular hydrodynamic seal (103) of claim 1, comprising:

A. said annular seal body (104) having a second seal end (136) generally facing the second fluid (124); and

B. said dynamic exclusionary intersection (139) being an intersection between said annular sloping dynamic sealing surface (140) and said second seal end (136).

12. (Original) The annular hydrodynamic seal (103) of claim 1, comprising:

said annular seal body (104) having a second seal end (136) projecting outward in a generally convex configuration in the uncompressed condition thereof.

13. (Original) The annular hydrodynamic seal (103) of claim 1, wherein:

said annular seal body (104) having a second seal end (136) defining an annular recess (167), said at least one energizer feature (163) being located within said annular recess (167).

14. (Currently amended) The annular hydrodynamic seal (103) of claim 2, wherein:

said first seal end (133) ~~varying in position substantially in time with said position of said at least one hydrodynamic inlet curvature (142)~~ is wavy.

15. (Currently amended) The annular hydrodynamic seal (103) of claim 1, comprising:

said ~~at least one resilient annular dynamic sealing lip (127) defining a hydrodynamic wedging angle with respect to the relatively rotatable surface (115) for~~ first footprint edge (157) hydrodynamically wedging a lubricating film of the first fluid (121) into said dynamic sealing interface in response to relative rotational velocity, causing the lubricating film to migrate within said dynamic sealing interface toward said second footprint edge (160) and into the second fluid (124).

16. (Original) The annular hydrodynamic seal (103) of claim 1, comprising:

said at least one energizer feature (163) being an annular spring of generally C-shaped cross-sectional configuration.

17. (Original) The annular hydrodynamic seal (103) of claim 1, wherein:

A. said annular seal body (104) defining a depth dimension (D) from said annular static sealing surface (131) to said annular sloping dynamic sealing surface (140);

B. said annular seal body (104) having a second seal end (136) and defining a length dimension (L) from said first seal end (133) to said second seal end (136);

C. the ratio of said length dimension (L) divided by said depth dimension (D) being greater than 1.2;

D. said annular seal body (104) defining a dynamic control surface (145) facing the relatively rotatable surface (115) and resisting cross-sectional twisting of said annular seal body (104);

E. said annular seal body (104) defining a static control surface (148) facing the first machine component (109) and resisting cross-sectional twisting of said annular seal body (104); and

F. said dynamic control surface (145) and said static control surface (148) being in generally oppositely oriented relation to one another.

18. (Original) The annular hydrodynamic seal (103) of claim 17, wherein:

said ratio of said length dimension (L) divided by said depth dimension (D) being in the range of 1.4 to 1.6.

19. (Currently amended) The annular hydrodynamic seal (103) of claim 2, wherein:

A. said annular seal body (104) defining a depth dimension (D) from said annular static sealing surface (131) to said annular sloping dynamic sealing surface (140); and

B. the magnitude of said depth dimension (D) varying substantially locally in time with said ~~position of said at least one hydrodynamic inlet curvature (142)~~ varying width (W).

20. (Original) The annular hydrodynamic seal (103) of claim 1, wherein:

said at least one resilient annular dynamic sealing lip (127) projecting radially inward from said annular seal body (104).

21. (Original) The annular hydrodynamic seal (103) of claim 1, wherein:

said at least one resilient annular dynamic sealing lip (127) projecting radially outward from said annular seal body (104).

22. (Original) The annular hydrodynamic seal (103) of claim 2, wherein:

said at least one hydrodynamic inlet curvature (142) is present prior to said compression of said at least one resilient annular dynamic sealing lip (127) against the relatively rotatable surface (115).

23. (Canceled)

24. (Original) The annular hydrodynamic seal (103) of claim 1, wherein:

an annular static sealing lip (128) in generally opposed relation to said at least one resilient annular dynamic sealing lip (127) and defining said annular static sealing surface (131).

25. (Original) The annular hydrodynamic seal (103) of claim 24, comprising:

said at least one energizer feature (163) defining said annular static sealing lip (128).

26. (Original) The annular hydrodynamic seal (103) of claim 24, comprising:

said at least one energizer feature (163) being located between said at least one resilient annular dynamic sealing lip (127) and said annular static sealing lip (128).

27. (Original) The annular hydrodynamic seal (103) of claim 1, comprising:

said at least one energizer feature (163) being a generally annular member composed of an elastomer material having a modulus of elasticity less than the modulus of elasticity of said annular seal body (104).

28. (Original) The annular hydrodynamic seal (103) of claim 1, comprising:

said at least one annular sloping dynamic sealing surface (140) being disposed in angulated relation with the relatively rotatable surface (115).

29. (Currently amended) The annular hydrodynamic seal (103) of claim 1, comprising:

said ~~dynamic sealing~~ interfacial contact footprint having greater interfacial contact pressure at said second footprint edge (160) resulting from deformation of said annular sloping dynamic sealing surface (140) as compared with interfacial contact pressure at said first footprint edge (157).

30. (Original) The annular hydrodynamic seal (103) of claim 1, comprising:

said at least one energizer feature (163) loading said annular static sealing surface (131) into compressed sealing relation with the first machine component (109).

31. (Currently amended) The annular hydrodynamic seal (103) of claim ~~23~~ 42, comprising:

said annular seal body (104) having a second seal end (136) that is curved in the uncompressed condition thereof.

32. (Currently amended) An annular hydrodynamic sealing assembly comprising:

A. a first machine component (109) defining at least a portion of a lubricant chamber (122) containing a lubricating fluid (121);

B. a second machine component (118) having a relatively rotatable surface (115);

C. an annular hydrodynamic seal (103) ~~defining a sealed partition between~~ partitioning said lubricating fluid (121) ~~and~~ from a fluid environment (124), comprising:

i. at least one resilient annular dynamic sealing lip (127) having at least one annular sloping dynamic sealing surface (140) and having a generally circular dynamic exclusionary intersection (139) facing the fluid environment (124) for preventing intrusion of the fluid environment (124) into said lubricating fluid (121);

ii. an annular static sealing surface (131) defining a static sealing interface with the first machine component (109);

iii. at least one energizer feature (163);

~~D. Said~~ D. said at least one energizer feature (163) compressing at least a portion of said at least one annular sloping dynamic sealing surface (140) into sealing relation with said relatively rotatable surface (115), said at least a portion of said at least one annular sloping dynamic sealing surface (140) being deformed by and assuming the configuration of said relatively rotatable surface (115) and defining a dynamic sealing interface establishing an interfacial contact footprint having varying width (W) throughout the circumference ~~thereof ,~~ thereof, said interfacial contact footprint having a first footprint edge (157) facing the lubricant chamber (122) and the lubricating fluid (121) and having a second generally circular footprint edge (160) facing the fluid environment (124);

E. said at least one resilient annular dynamic sealing lip (127) defining a hydrodynamic wedging angle (158) with respect to said relatively rotatable surface (115) proximate said first footprint edge (157); and

F. said at least one resilient annular dynamic sealing lip (127) hydrodynamically wedging a lubricating film of the lubricating fluid (121) into said dynamic sealing interface in response to relative rotational velocity, causing said lubricating film to migrate within said dynamic sealing interface toward said second generally circular footprint edge (160) and into the fluid environment (124).

33. (Currently amended) An annular hydrodynamic seal (103) for sealing between a first machine component (109) and a second machine component (118) having a relatively rotatable surface (115) and ~~defining a sealed partition between~~ partitioning a lubricant chamber (122) of the first machine component (109) having a first fluid (121) ~~and~~ from an environment having a second fluid (124), comprising:

A. an annular seal body (104) having a first seal end (133) and a second seal end (136);

B. at least one resilient annular dynamic sealing lip (127) having an at least one annular sloping dynamic sealing surface (140) and having at least one dynamic exclusionary intersection ~~(139~~ (139) for facing and preventing intrusion of the second fluid (124);

C. upon compression of said at least one resilient annular dynamic sealing lip (127) against the relatively rotatable surface (115) at least a portion of said at least one annular sloping dynamic sealing surface (140) being deformed by and assuming the configuration of the relatively rotatable surface (115) and defining a dynamic sealing interface establishing an

interfacial contact footprint having varying width (W) throughout the circumference thereof and having a first footprint edge (157) facing the first fluid (121) within the lubricant chamber (122) and a second footprint edge (160) facing the second fluid (124);

D. an annular static sealing surface (131) defining a static sealing interface with the first machine component (109);

E. said second seal end (136) defining an annular recess (167) intermediate said at least one resilient annular dynamic sealing lip (127) and said annular static sealing surface (131); and

F. said at least one resilient annular dynamic sealing lip (127) defining a hydrodynamic wedging angle (158) with respect to the relatively rotatable surface (115) for hydrodynamically wedging a lubricating film of the first fluid (121) into said dynamic sealing interface in response to relative rotational velocity, causing the lubricating film to migrate within said dynamic sealing interface toward the second footprint edge (160) and into the second fluid (124).

34. (Currently amended) The annular hydrodynamic seal (103) of claim ~~1~~ 33, wherein:

said at least one resilient annular dynamic sealing lip (127) defining at least one hydrodynamic inlet curvature (142) that varies in position for providing hydrodynamic wedging action in response to relative rotation, said at least one annular sloping dynamic sealing surface (140) being located between said hydrodynamic inlet curvature (142) and said at least one dynamic exclusionary intersection (139) and having varying width.

35. (Currently amended) The annular hydrodynamic seal (103) of claim 1, wherein:

said first seal end (133) ~~varying in position substantially in time with said position of said at least one hydrodynamic inlet curvature (142)~~ is wavy.

36. (Currently amended) The annular hydrodynamic seal (103) of claim ~~1~~ 33, wherein:

A. said annular seal body (104) defining a depth dimension (D) from said annular static sealing surface (131) to said at least one annular sloping dynamic sealing surface (140);

B. said annular seal body (104) defining a length dimension (L) from said first seal end (133) to said second seal end (136);

C. the ratio of said length dimension (L) divided by said depth dimension (D) being greater than 1.2;

D. said annular seal body (104) defining a dynamic control surface (145) facing the relatively rotatable surface (115) and resisting cross-sectional twisting of said annular seal body (104);

E. said annular seal body (104) defining a static control surface (148) facing the first machine component (109) and resisting cross-sectional twisting of said annular seal body (104); and

F. said dynamic control surface (145) and said static control surface (148) being in generally oppositely oriented relation to one another.

37. (Currently amended) The annular hydrodynamic seal (103) of claim ~~1~~ 33, wherein:

said at least one resilient annular dynamic sealing lip (127) projecting radially inward from said annular seal body (104).

38. (Original) The annular hydrodynamic seal (103) of claim 1, wherein:

said at least one resilient annular dynamic sealing lip (127) projecting radially outward from said annular seal body (104).

39. (Currently amended) The annular hydrodynamic seal (103) of claim ~~1~~ 33, wherein:

said at least one resilient annular dynamic sealing lip (127) projecting axially from said annular seal body (104).

40. (Original) The annular hydrodynamic seal (103) of claim 34, wherein:

said at least one hydrodynamic inlet curvature (142) is present prior to said compression of said at least one resilient annular dynamic sealing lip (127) against the relatively rotatable surface (115).

41. (Currently amended) The annular hydrodynamic seal (103) of claim ~~1~~ 33, wherein:

an annular static sealing lip (128) in generally opposed relation to said at least one resilient annular dynamic sealing lip (127) and defining said annular static sealing surface (131).

42. (New) An annular hydrodynamic seal (103) for sealing between a first machine component (109) and a second machine component (118) having a relatively rotatable surface (115) and partitioning a lubricant chamber (122) of the first machine component (109) having a first fluid (121) from an environment having a second fluid (124), comprising:

A. an annular seal body (104) being solid in cross-section and having a first seal end (133) and a second seal end (136) and defining a length dimension (L) from said first seal end (133) to said second seal end (136);

B. said annular seal body (104) defining a resilient annular dynamic sealing lip (127) having an annular sloping dynamic sealing surface (140);

C. a dynamic exclusionary intersection (139) with said annular sloping dynamic sealing surface (140) for facing and preventing intrusion of the second fluid (124);

D. upon compression of said resilient annular dynamic sealing lip (127) against the relatively rotatable surface (115) at least a portion of said annular sloping dynamic sealing surface (140) being deformed by and assuming the configuration of the relatively rotatable surface (115) and defining a dynamic sealing interface establishing an interfacial contact footprint having varying width (W) throughout the circumference thereof and having a first footprint edge (157) facing the lubricant chamber (122) and the first fluid (121) and a second footprint edge (160) facing the second fluid (124);

E. an annular static sealing surface (131) defining a static sealing interface with the first machine component (109);

F. said annular seal body (104) defining a dynamic control surface (145) facing the relatively rotatable surface (115) and resisting cross-sectional twisting of said annular seal body (104);

G. said annular seal body (104) defining a static control surface (148) facing the first machine component (109) and resisting cross-sectional twisting of said annular seal body (104),

said dynamic control surface (145) and said static control surface (148) being in generally oppositely oriented relation to one another; and

H. said annular seal body (104) defining a depth dimension (D) from said annular static sealing surface (131) to said annular sloping dynamic sealing surface (140), and the ratio of said length dimension (L) divided by said depth dimension (D) being greater than 1.2.